

**WHAT IS CLAIMED IS:**

1 [C1] 1. A digital image system capable of receiving digital image data representing at  
2 least part of a digital image and mapping said digital image data onto the range of an output  
3 device, said digital image system comprising:

4 an image statistics processor capable of calculating at least one current image  
5 statistic based on said digital image data;

6 calculation logic connected to receive said at least one current image statistic  
7 from said image statistics processor and further being capable of calculating at least one tone  
8 curve parameter based on said at least one current image statistic and at least one perceptual  
9 preference associated with said digital image system; and

10 a tone curve generator connected to receive said at least one tone curve  
11 parameter from said calculation logic and further being capable of generating a tone curve  
12 using said at least one tone curve parameter and a sigmoidal function, said tone curve being  
13 used to map said digital image data onto the range of said output device.

1 [C2] 2. The system of Claim 1, further comprising:

2 a linear transformation device connected to receive said digital image data,  
3 convert said digital image data into linear image data and transmit said linear image data to  
4 said image statistics processor, said image statistics processor using said linear image data in  
5 calculating said at least one current image statistic.

[C3] 3. The system of Claim 2, wherein said image statistics processor comprises:  
a histogram generator connected to receive said linear image data and generate  
a histogram of the pixel values represented by said linear image data, said histogram  
containing a plurality of bins representing respective ranges of pixel values and a count of the  
number of pixel values represented by said linear image data within each of said plurality of  
bins;  
a converter capable of converting a bin center value for each of said bins  
associated with said histogram from a linear scale to an  $L^*$  scale to produce a plurality of  $L^*$   
bin center values; and  
statistics calculation logic connected to receive said count from said histogram  
generator and said plurality of  $L^*$  bin center values from said converter and calculate said at  
least one current image statistic using said count and said plurality of  $L^*$  bin center values.

[C3] 4. The system of Claim 3, further comprising:  
a memory for storing said plurality of  $L^*$  bin center values prior to said  
histogram being generated, said statistics calculation logic retrieving said plurality of  $L^*$  bin  
center values in response to receiving said count.

[C5] 5. The system of Claim 1, wherein said at least one tone curve parameter includes  
a slope parameter and a shift parameter and wherein said at least one current image statistic

includes a current  $L^*$  standard deviation and one of a current mean  $L^*$  value or low and high  $L^*$  percentile values.

[C6] 6. The system of Claim 5, wherein said at least one perceptual preference includes a desired  $L^*$  standard deviation and one of a desired mean  $L^*$  value or a centering function, said slope parameter being calculated using said current  $L^*$  standard deviation and said desired  $L^*$  standard deviation, said shift parameter being calculated using either said current mean  $L^*$  value and said desired mean  $L^*$  value or said low and high  $L^*$  percentile values and said centering function.

[C7] 7. The system of Claim 6, further comprising:  
an upper pre-selected mean  $L^*$  value and an associated upper pre-selected shift value, said shift parameter being set to said upper pre-selected shift value when said current mean  $L^*$  value is less than said upper pre-selected mean  $L^*$  value and said calculated shift parameter is less than said upper pre-selected shift value; and  
a lower pre-selected mean  $L^*$  value and an associated lower pre-selected shift value, said shift parameter being set to said lower pre-selected shift value when said current mean  $L^*$  value is greater than said lower pre-selected mean  $L^*$  value and said calculated shift parameter is greater than said lower pre-selected shift value.

1 [C8] 8. The system of Claim 5, further comprising a memory for storing first and  
2 second pre-calculated tone curves generated by said tone curve generator prior to said digital  
3 image system receiving said digital image data, said first pre-calculated tone curve having a  
4 minimum slope and said second pre-calculated tone curve having a maximum slope.

1 [C9] 9. The system of Claim 8, wherein said tone curve generator comprises:  
2 calculation logic connected to receive said slope parameter and said first and  
3 second pre-calculated tone curves, said calculation logic being further capable of interpolating  
4 between said first and second pre-calculated tone curves using said slope parameter to obtain  
5 an initial tone curve; and  
6 shifting logic connected to receive said initial tone curve and said shift  
7 parameter, said shifting logic being further capable of shifting said initial tone curve on the X-  
8 axis using said shift parameter to produce said tone curve used in mapping said digital image  
9 data onto the range of said output device.

1 [C10] 10. The system of Claim 1, wherein said tone curve generator further comprises:  
2 gamma correction logic for applying gamma correction to the Y-axis of said  
3 tone curve; and  
4 a converter for converting the X-axis of said tone curve to the scale of said  
5 digital image data.

1 [C11] 11. A method for mapping digital image data representing at least part of a digital  
2 image onto the range of an output device, said method comprising:  
3 receiving said digital image data at a digital image system;  
4 calculating at least one current image statistic based on said digital image data;  
5 calculating at least one tone curve parameter based on said at least one current  
6 image statistic and at least one perceptual preference; and  
7 generating a tone curve using said at least one tone curve parameter and a  
8 sigmoidal function, and using said tone curve to map said digital image data onto the range of  
9 said output device.

1 [C12] 12. The method of Claim 11, wherein said step of calculating said at least one  
2 current image statistic further comprises:  
3 converting said digital image data into linear image data; and  
4 calculating said at least one current image statistic using said linear image data.

1 [C13] 13. The method of Claim 12, wherein calculating said at least one current image  
2 statistic further comprises:  
3 generating a histogram of the pixel values represented by said linear image  
4 data, said histogram containing a plurality of bins representing respective ranges of pixel  
5 values and a count of the number of pixel values represented by said linear image data within  
6 each of said plurality of bins;  
7 converting a bin center value for each of said bins associated with said  
8 histogram from a linear scale to an  $L^*$  scale to produce a plurality of  $L^*$  bin center values;  
9 and  
10 calculating said at least one current image statistic using said count and said  
11 plurality of  $L^*$  bin center values.

1 [C14] 14. The method of Claim 13, wherein converting said bin centers further  
2 comprises:  
3 converting said bin center values to produce a plurality of  $L^*$  bin center values  
4 prior to said step of generating; and  
5 storing said plurality of  $L^*$  bin center values within a memory.

[C15] 15. The method of Claim 11, wherein said at least one tone curve parameter includes a slope parameter and a shift parameter and wherein said at least one current image statistic includes a current  $L^*$  standard deviation and one of a current mean  $L^*$  value or low and high  $L^*$  percentile values.

[C16] 16. The method of Claim 15, wherein said at least one perceptual preference includes a desired  $L^*$  standard deviation and one of a desired mean  $L^*$  value or a centering function, calculating said at least one tone curve parameter further comprising:  
calculating said slope parameter using said current  $L^*$  standard deviation and said desired  $L^*$  standard deviation; and  
calculating said shift parameter using either said current mean  $L^*$  value and said desired mean  $L^*$  value or said low and high  $L^*$  percentile values and said centering function.

1 [C17] 17. The method of Claim 16, wherein calculating said at least one tone curve  
2 parameter further comprises:

3 setting said shift parameter to be equal to an upper pre-selected shift value  
4 when said current mean  $L^*$  value is less than an upper pre-selected mean  $L^*$  value  
5 associated with said upper pre-selected shift value and said calculated shift parameter is less  
6 than said upper pre-selected shift value; and

7 setting said shift parameter to be equal to a lower pre-selected shift value when  
8 said current mean  $L^*$  value is greater than a lower pre-selected mean  $L^*$  value associated  
9 with said lower pre-selected shift value and said calculated shift parameter is greater than said  
10 lower pre-selected shift value.

1 [C18] 18. The method of Claim 15, wherein generating further comprises:

2 generating first and second pre-calculated tone curves prior to said step of  
3 receiving said digital image data, said first pre-calculated tone curve having a minimum slope  
4 and said second pre-calculated tone curve having a maximum slope.



1 [C19] 19. The method of Claim 18, wherein generating said tone curve used in mapping  
2 said digital image data onto the range of said output device comprises:  
3 interpolating between said first and second pre-calculated tone curves using  
4 said slope parameter to obtain an initial tone curve; and  
5 shifting said initial tone curve on the X-axis using said shift parameter to  
6 produce said tone curve used in mapping said digital image data onto the range of said output  
7 device.

1 [C20] 20. The method of Claim 11, wherein generating said tone curve comprises:  
2 applying gamma correction to the Y-axis of said tone curve; and  
3 converting the X-axis of said tone curve to the scale of said digital image data.